

WHAT IS CLAIMED IS:

1. An apparatus for detecting the presence of contaminant particles on a surface of a semiconductor wafer having repetitive patterns, said apparatus comprising:
- (a). means for producing a first beam of light and a second beam of light,
 - (b). first optical means for illuminating a first region area on the semiconductor wafer with said first beam of light,
 - (c). second optical means for illuminating a second region on the semiconductor wafer ample with said second beam of light,
 - (d). said first beam of light striking the semiconductor wafer at a first approach angle which is angularly adjustable and a first angle of incidence which is angularly adjustable,
 - (e). said second beam of light striking the semiconductor wafer at a second approach angle which is angularly adjustable and a second angle of incidence which is angularly adjustable,
 - (f). said first approach angle and said first angle of incidence being adjustable independent of said second approach angle and said second angle of incidence, respectively,
 - (g). an imaging detector disposed above the semiconductor wafer for detecting light scattered from the area illuminated but not specularly reflected light,
 - (h). an imaging lens for imaging said area illuminated on said imaging detector, and
 - (i). a spatial filter in the Fourier plane of the imaging lens for masking off the diffraction pattern produced by the background on the semiconductor wafer from each one of the two illuminating beams of light.

2. An apparatus for detecting the presence of contaminant particles on a semiconductor wafer having repetitive patterns, said apparatus comprising:

- (a). means for producing a first beam of light and a second beam of light,
 - (b). first optical means for illuminating a first region on the semiconductor wafer with said first beam of light,
 - (c). second optical means for illuminating a second region on the semiconductor wafer with said second beam of light,
 - (d). said first beam of light striking the semiconductor wafer at a first approach angle and a first angle of incidence,
 - (e). said second beam of light striking the semiconductor wafer at a second approach angle and a second angle of incidence,
 - (f). said first optical means including a variable angle mirror for varying the first angle of incidence,
 - (g). said second optical means including a variable angle mirror for varying the second angle of incidence,
 - (h). a first tower for holding said first optical means, said first tower being angularly movable so as to change said first approach angle,
 - (i). a second tower for holding said second optical means, said second tower being angularly movable so as to change said second approach angle,
 - (j). said first approach angle and said first angle of incidence being adjustable independent of said second approach angle and said second angle of incidence, respectively,
 - (k). an imaging detector disposed above the semiconductor wafer for detecting light scattered from the area illuminated but not specularly reflected light,
 - (l). an imaging lens for imaging said area illuminated on said imaging detector,
- and

(m). a spatial filter in the Fourier plane of the imaging lens for masking off the diffraction pattern produced by the background on the semiconductor wafer from both illuminating beams of light.

3. A method for detecting the presence of contaminant particles on a semiconductor wafer having repetitive patterns, said apparatus comprising:

(a). illuminating a portion of the semiconductor wafer with first and second beams of light,

(b). said first beam of light striking the semiconductor wafer at a first approach angle which is angularly adjustable and a first angle of incidence which is angularly adjustable,

(c). said second beam of light striking the semiconductor wafer at a second approach angle which is angularly adjustable and a second angle of incidence which is angularly adjustable,

(d). said first approach angle and said first angle of incidence being adjustable independent of said second approach angle and said second angle of incidence, respectively,

(e). adjusting said first and second approach angles to minimize background scatter,

(f). positioning an imaging detector above the semiconductor wafer for detecting at least some of the light scattered from the area illuminated but not specularly reflected light,

(g). providing an imaging lens for imaging said area illuminated on said imaging detector,

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(h). providing a spatial filter in the Fourier plane of the imaging lens for masking off the diffraction pattern produced by the background on the semiconductor wafer from a first one of the two beams of light, and

(i). adjusting said angle of incidence of the other beam of light so that the diffraction pattern formed by the other beam of light in the Fourier plane overlaps the diffraction pattern formed by the first beam of light.

4. An apparatus for detecting the presence of contaminant particles on a semiconductor wafer having repetitive patterns, said apparatus comprising:

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(a). a light source adapted to produce a first beam of light and a second beam of light, said first beam of light being disposed to illuminate a region on the semiconductor wafer at a first approach angle which is angularly adjustable and a first angle of incidence which is angularly adjustable, said second beam of light being disposed to illuminate another region on the semiconductor wafer at a second approach angle which is angularly adjustable and a second angle of incidence which is angularly adjustable, the first approach angle and the first angle of incidence of said first beam of light being adjustable independent of the second approach angle and the second angle of incidence of said second beam of light,

(b). an imaging detector disposed to detect light scattered from the regions illuminated but not light specularly reflected from the area illuminated,

(c). an imaging lens for imaging the regions illuminated on said imaging detector, said imaging lens having a Fourier plane, and

(d). a spatial filter disposed in the Fourier plane of said imaging lens for masking off the diffraction pattern produced by the background of the semiconductor wafer from both beams of light.

5. An apparatus for detecting the presence of contaminant particles on a semiconductor wafer having repetitive patterns, said apparatus comprising:

(a). a first tower producing a first beam of light, the first beam of light illuminating a first region on the semiconductor wafer at a first approach angle and at a first angle of incidence, said first tower being angularly movable so as to change the first approach angle,

(b). a second tower producing a second beam of light, the second beam of light illuminating a second region on the semiconductor wafer as the first beam of light, the second beam of light illuminating the semiconductor wafer at a second approach angle and at a second angle of incidence, said second tower being angularly movable so as to change the second approach angle, said second tower being angularly movable independent of said first tower,

(c). an imaging detector disposed to detect light scattered from the regions illuminated but not light specularly reflected from the area illuminated,

(d). an imaging lens for imaging the area illuminated on said imaging detector, said imaging lens having a Fourier plane, and

(e). a spatial filter disposed in the Fourier plane of said imaging lens for masking off the diffraction pattern produced by the background of the semiconductor wafer from both beams of light.

6. The apparatus of claim 5 wherein said first tower includes a variable angle mirror for varying the first angle of incidence.

7. The apparatus of claim 6 wherein said second tower includes a variable angle mirror for varying the second angle of incidence.

8. The apparatus of claim 7 wherein the variable angle mirror of said second tower is movable independent of the variable angle mirror of said first tower.

9. The apparatus of claim 8 wherein said first tower further comprises a gimbal mirror, a pair of lenses and a pair of folding mirrors.

10. The apparatus of claim 9 wherein said second tower further comprises a gimbal mirror, a pair of lenses and a pair of folding mirrors.

11. An apparatus for detecting the presence of contaminant particles on a surface of a semiconductor wafer having repetitive patterns, said apparatus comprising:

- (a). a holder for holding said semiconductor wafer,
- (b). a light source adapted to produce a first beam of light and a second beam of light, said first beam of light being disposed relative to the semiconductor wafer to illuminate a first stripe shaped region on the semiconductor wafer at a first approach angle, said second beam of light being disposed to illuminate a second stripe shaped region on the semiconductor wafer at a second approach angle, said second, stripe shaped region intersecting said first stripe shaped region,
- (c). a CCD camera, said CCD camera being operational in a time delayed integration (TDI) mode,
- (d). an imaging lens disposed above the two stripe shaped regions for imaging onto said CCD camera at least a portion at an area on the surface containing at least a portion of the two stripe shaped regions using scattered light as the semiconductor wafer is moving, the imaging lens having a Fourier plane,

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reflected light

(e).forming an image of the area illuminated using scattered light and a CCD camera operational in a time delayed integration (TDI) mode, and

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lens

(f). masking off from the image formed the diffraction pattern produced by the lens from the background on the semiconductor wafer.

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16. The method of claim 14 and wherein said first and second regions intersect within the field of view of the CCD camera.

17. The method of claim 15 and wherein said first and second regions intersect at the center of the field of view of the CCD camera.

18. An apparatus for detecting the presence of contaminant particles on a semiconductor wafer having repetitive patterns, said apparatus comprising:

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(a). a holder for holding said semiconductor wafer, movable along two mutually perpendicular axes,

(b). a pair of linear motors for moving said holder translationally along two mutually perpendicular axes,

(c). a light source for illuminating a stripe shaped region on the semiconductor wafer,

(d). a CCD camera having a square array sensor and constructed to operate in a time delayed integration (TDI) mode disposed to detect light scattered from the strip illuminated but not light specularly reflected from the area illuminated,

(e). an imaging lens for imaging continuously the area illuminated by the stripe shaped region on said imaging detector as said holder is moved, said imaging lens having a Fourier plane, and

(f). a filter disposed in the Fourier plane of said imaging lens for masking off the diffraction pattern produced by the background of the semiconductor wafer from the beam of light.

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